water is drawn in from all directions and the corresponding increase in hydraulic gradient and velocity may draw pollutant into the well faster than overall aquifer analysis may indicate. The size of the cone is dependent on the rate at which water is withdrawn from the well, aquifer properties at the well, and the velocity at which water moves through the aquifer.

Sometimes the cone of depression from one well will overlap that of another well. When this happens, the well with the wider, deeper cone of depression could draw water away from the smaller well. Wells which pump large volumes of water may locally change the direction of groundwater flow (Figure 5).

GROUNDWATER SYSTEMS IN IDAHO

The main types of aquifers occurring in Idaho are composed of unconsolidated sedimentary deposits, basalt, or a combination of sedimentary and volcanic deposits (Figure 6).

Valley-fill aquifers are composed of unconsolidated sedimentary materials in intermountain valleys. They yield sufficient water for domestic use and farming activities. In northern Idaho, these aquifers consist of glacial outwash with some recent alluvium. The principal aquifer is the Spokane Valley-Rathdrum Prairie Aquifer. This aquifer has extremely high transmissivities (the ability for groundwater to move) which result in very low drawdown in high-yielding wells.

Basalt aquifers are characterized by numerous basalt flows and thin, interbedded sediments. The principal aquifer of this type and also the principal aquifer in Idaho is the Snake Plain Aquifer which extends from Ashton to Bliss. This aquifer system discharges nearly 8 million acre feet annually to the Snake River. The Snake Plain Aquifer is one of the most productive aquifers in the nation.

Two smaller basalt aquifers occur in the Lewiston-Moscow area and the Weiser River Basin. Although they have much smaller yields than the Snake Plain Aquifer, they provide most of the domestic water and significant agricultural water for their regions.

Sedimentary and volcanic aquifers, which occur chiefly in the western Snake Plain, are composed of gravels, sand, silt and clay, interbedded with basalt, shale, and sandstone. Significant geothermal waters are found in some areas of these aquifers. Such systems are found in the Boise Valley, Mountain Home area and south of the Snake River at Buhl and Twin Falls. These geothermal systems are formed by the upwelling of heated water along faults and fissures.

The principal recharge to Idaho aquifers is from snowmelt via streams and rivers. Only 2 to 5 percent of the recharge is attributed to precipitation directly over the aquifers. Recharge from man’s activities impacts groundwater quantity and quality. Percolation of irrigation waters, return flows through injection wells, land-applied wastewaters and septic tank systems all have the potential to adversely affect groundwater quality.

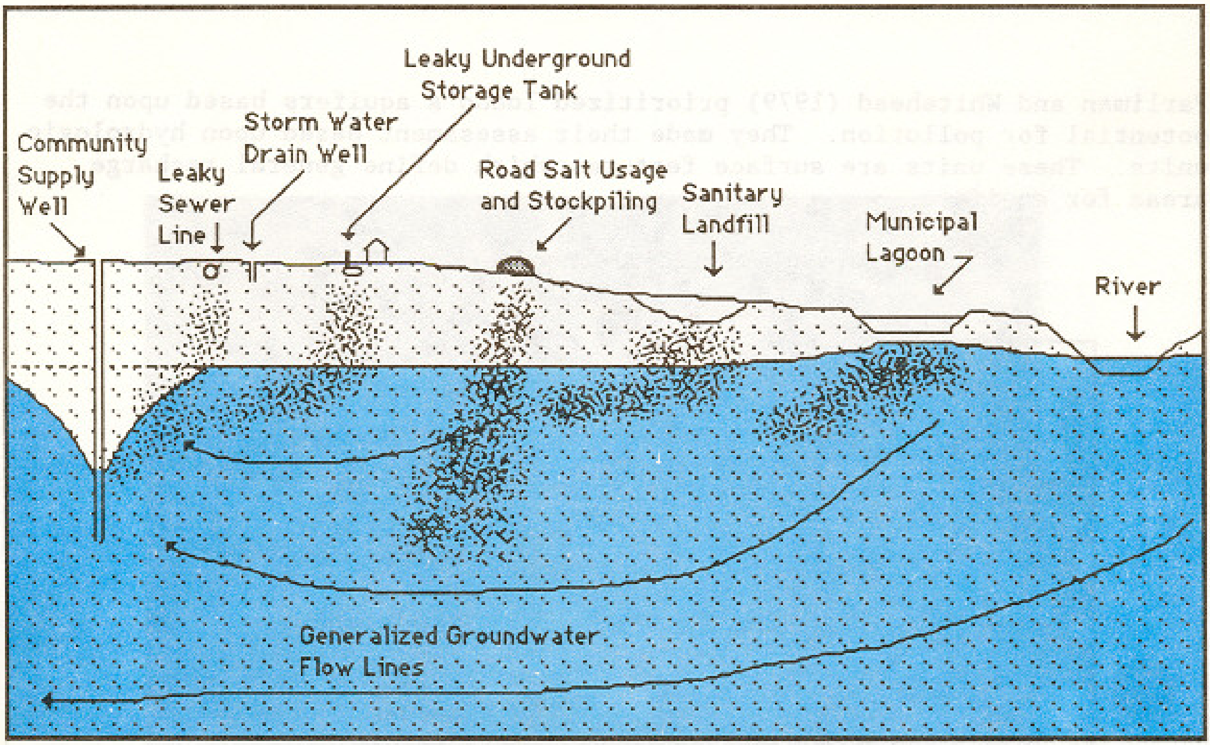


Figure 4: Diagram showing how contaminants may be introduced into groundwater

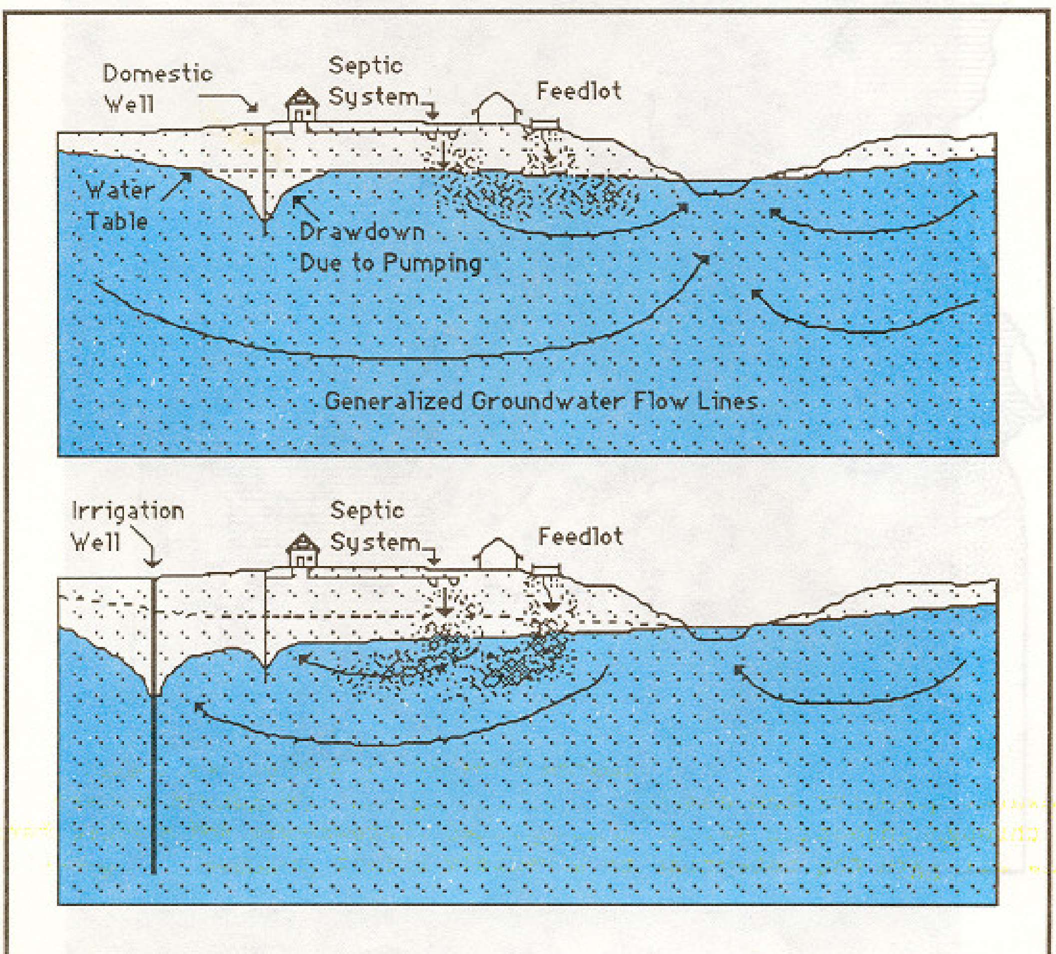
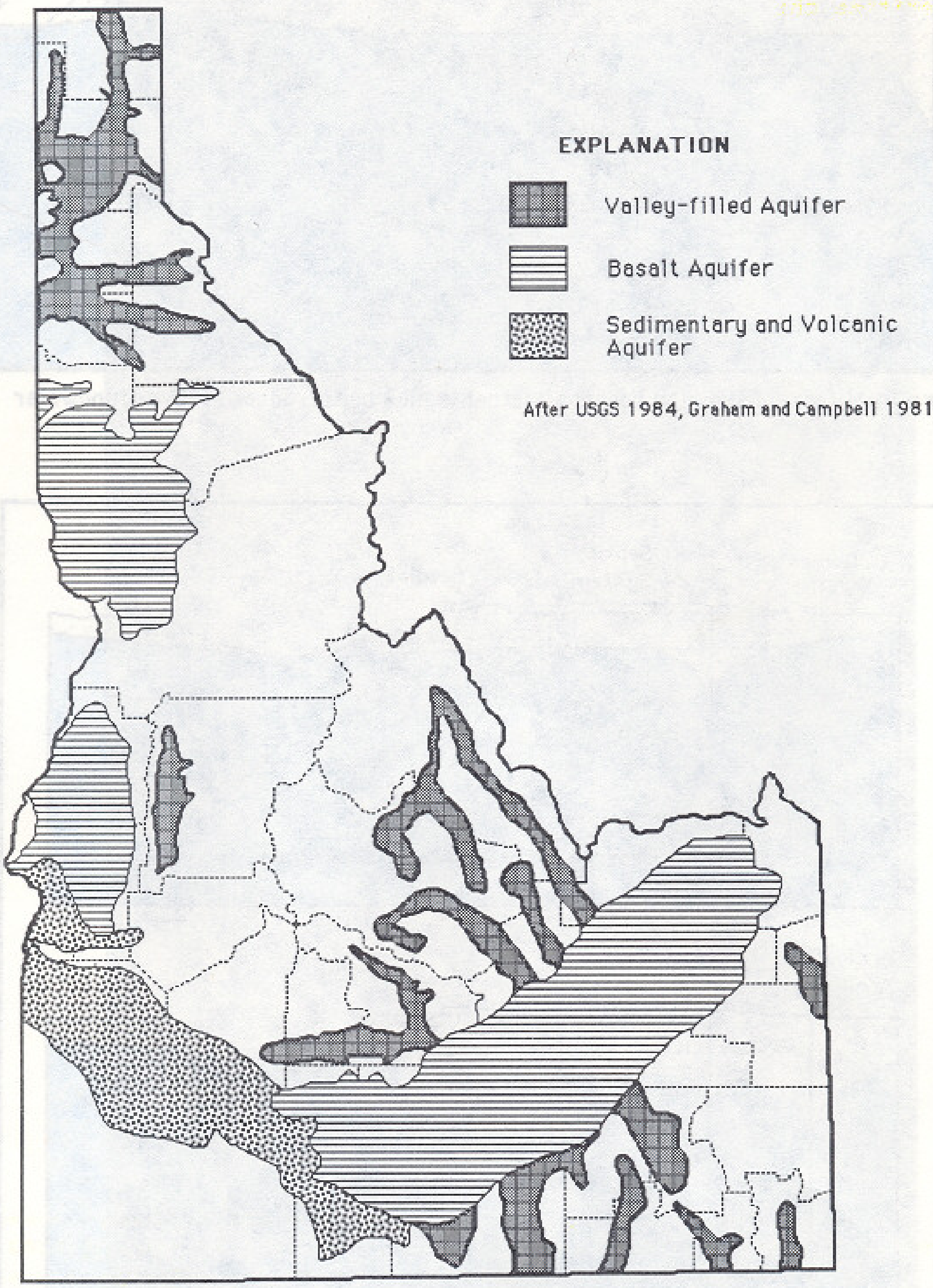


Figure 5: Diagram showing how pumping may affect the direction of groundwater flow

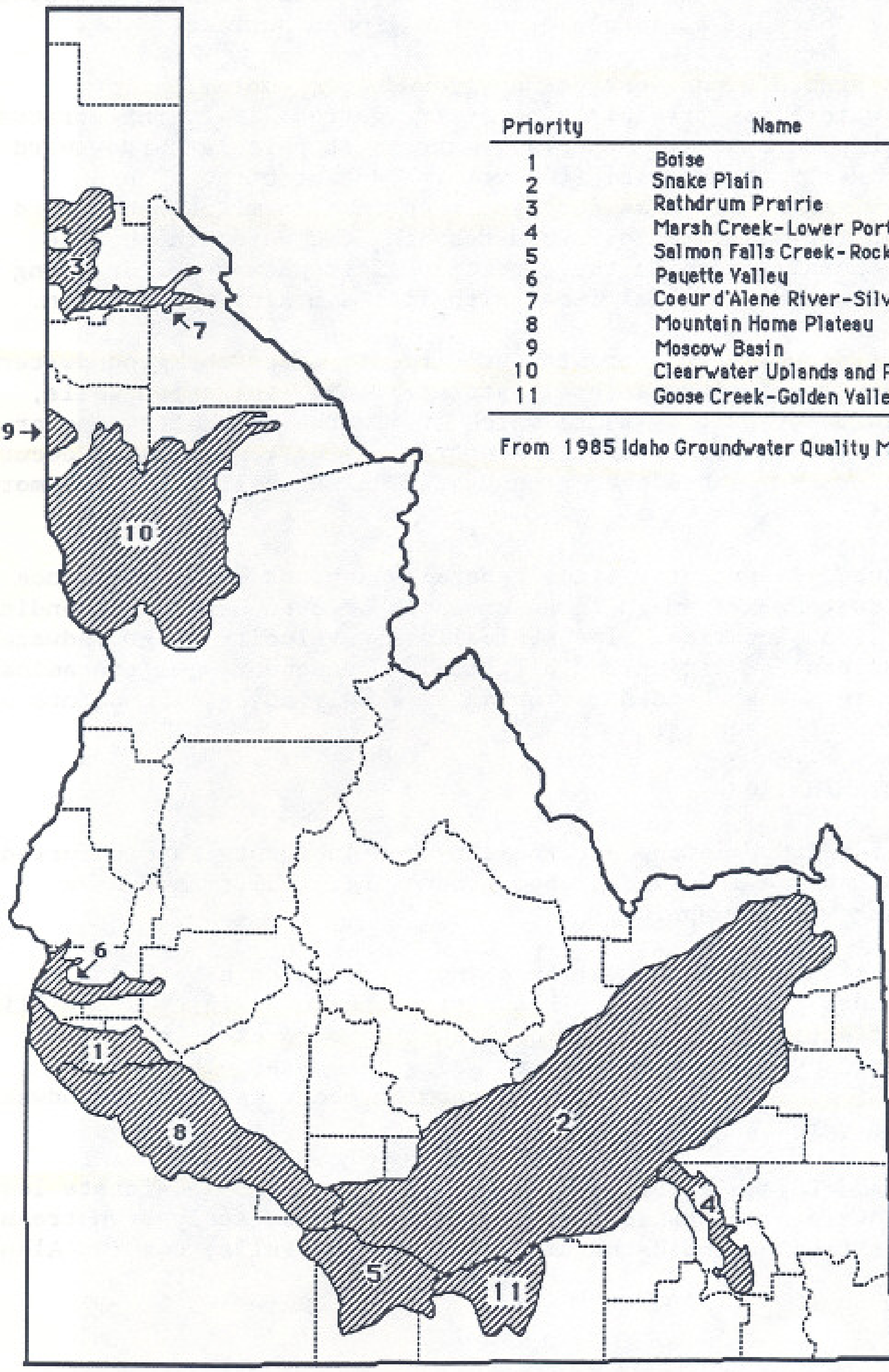
Parliman and Whitehead (1979) prioritized Idaho's aquifers based upon the potential for pollution. They made their assessment based upon hydrologic units. These units are surface features which define general recharge areas for aquifers.

Figure 6. Principle Aquifers of Idaho



Applying the same rating system directly to major aquifers, their potential for pollution can be determined. These aquifers, ranked in priority, are shown in Figure 7. Aquifers ranked first are those with the greatest potential for pollution. The pollution potential for the major aquifers in Idaho is based on an initial assessment by Parliman and Whitehead (1979) and updated in the 1985 Groundwater Quality Management Plan for Idaho. These initial assessments were made utilizing land use patterns, population density, groundwater use and groundwater vulnerability. Results of the pending groundwater vulnerability assessment and additional monitoring may reprioritize this ranking scheme or create priority subsections within the major aquifers.

Figure 7. Pollution Potential Rating of Major Idaho Aquifers



Priority	Name
1	Boise
2	Snake Plain
3	Rathdrum Prairie
4	Marsh Creek-Lower Portneuf
5	Salmon Falls Creek-Rock Creek
6	Payette Valley
7	Coeur d'Alene River-Silver Valley
8	Mountain Home Plateau
9	Moscow Basin
10	Clearwater Uplands and Plateau
11	Goose Creek-Golden Valley

From 1985 Idaho Groundwater Quality Management Plan

As water moves through the hydrologic cycle, its quality changes in response to differences in the physical, chemical, and biological environments through which it passes. Water has the ability to dissolve or leach and mobilize a variety of materials which it comes in contact with. These changes may be either natural or man-influenced. Contamination of groundwater occurs in a variety of ways, including infiltration, migration, and recharge from surface water. This contamination may be a result of neglect, accident, or design. Generally, shallow water is more susceptible than deeper water because it is closer to the ground surface.

Infiltration is probably the most common groundwater contamination mechanism. As water from precipitation or irrigation slowly infiltrates the soil through pore spaces in the soil matrix, it percolates downward and dissolves and mixes with material it comes in contact with. These dissolved contaminants, known as leachate, continue to migrate downward until they reach the water table. Upon reaching the water table, the leachate will generally move in the direction of groundwater flow along relatively straight and parallel lines with little mixing or dilution.

Direct migration occurs when contaminants directly enter the groundwater system from underground sources (e.g., storage tanks, injection wells, improperly installed septic systems) which lie in the saturated zone or seasonally saturated zone. Greater concentrations of contaminants occur from these sources and, therefore, groundwater vulnerability is much more acute.

Individual polluted groundwater sites generally are not large but, once polluted, groundwater may remain in an unusable or even hazardous condition for decades or even centuries. The typically low velocity of groundwater prevents a great deal of mixing and dilution. Consequently, a contaminant plume may maintain a high concentration as it slowly moves from points of recharge to zones of discharge.

EXAMPLES OF CONTAMINATION

Idaho is known for its pristine environment, yet incidents have occurred which, locally, have seriously degraded groundwater quality and have affected drinking water supplies.

Mining operations in the Silver Valley of northern Idaho have been continuous for more than 90 years. Leaching of the old mining and milling wastes is now affecting the chemical quality of groundwater in several areas, including Canyon Creek Basin near Wallace. Here, elevated concentrations of zinc, lead, copper, and cadmium occur in both groundwater and soil samples (Mink et al., 1972).

In 1977, Jones and Lustig reported a significant increase in nitrate levels over historical values in the aquifer beneath and immediately downstream from the major cities on the Rathdrum Prairie. Post Falls, Coeur d’Alene and Dalton Gardens had all experienced intense housing growth during the period of 1970 to 1977 and all utilized septic tanks and drainfields exclusively. While not dangerously high in 1977, the increased nitrate levels indicated a future trend if corrective actions were not taken. The Panhandle Health District adopted regulations requiring a five-acre minimum lot size for a septic system. This simple method has apparently stabilized the situation over the last 10 years.

Results of recent monitoring of groundwater at the Idaho National Engineering Laboratory (INEL) have detected carbon tetrachloride in samples of groundwater from one of five monitoring wells at concentrations of between 2 to 6 parts per billion at the Radioactive Waste Management Complex (RWMC). In addition, core samples taken at the RWMC have detected the presence of low levels of plutonium at depths of 33 meters (110 feet) and 70 meters (230 feet). An expanded monitoring program is under way to determine the extent of contamination and the most appropriate means of remedial action, if such action is required.

The test reactor waste pond at the INEL is known to require corrective action. Until 1970, this waste pond received discharges of potassium dichromate, which was used as an algicide and corrosion inhibitor in the cooling towers. As a result of this discharge to the pond, chromium has been detected in the groundwater underneath the pond. The extent of potential contamination has not been determined.

Injection wells are used to dispose of excess irrigation and surface runoff from approximately 320,000 acres of agricultural land within the eastern Snake River Plain. In 1977, the Idaho Department of Water Resources conducted a study to determine the effects of this practice on groundwater quality. Graham et al., 1977, reported that “deep percolation of injected wastewater resulted in bacterial contamination of both the deep perched water zone overlying the confining layer and the artesian groundwater system.” This effect is dependent upon the quality of the water being discharged to the injection well. Permits are required from the Idaho Department of Water Resources to operate these wells and they are periodically monitored to determine the quality of the injected water.

In 1987, groundwater contamination was discovered at the American Falls Airport. Apparently it was common practice to rinse spray plane pesticide tanks and dispose of this rinsate in a drain well. This practice has been discontinued, but the groundwater problem still remains.

In the summer of 1975, a gasoline-like odor and a frothy effervescence appeared in water from a Coeur d’Alene public supply well. Collected samples confirmed the presence of organic substances found in gasoline (Drost and Seitz, 1978). The source of the contamination was never established but possible sources include gasoline station drains and a reported accidental dumping of 500 gallons of gasoline into a nearby drywell.

A large groundwater cleanup project is underway in Boise where two million gallons of petroleum were released from an above-ground storage facility. Two similar remedial efforts have been conducted for leaking tanks in Fruitland and Weiser. Additional leaking tanks have been identified in

Boise, Caldwell, Nampa and Emmett. Investigations of groundwater contamination are underway at several military facilities. Of concern are petroleum storage and industrial solvents. Localized groundwater contamination from solvents has been found at two industrial properties in Boise and pentachlorophenol was detected in groundwater at a nearby pole treating facility. Other groundwater concerns include food processing facilities where process wastewater is applied to the land as a means of disposal.

In the Coeur d'Alene area, one landfill is under investigation for potential groundwater impacts and several industrial sites are being looked at for possible contamination from solvents. Releases of petroleum from a leaking underground tank recently resulted in groundwater contamination in Moscow.

Petroleum contamination of groundwater has been found in Preston, American Falls and Rockland. Leaking underground and above-ground storage tanks are the main source. Land application of food processing wastewater has caused localized area where high levels of iron, manganese and total organic carbon have been found in the groundwater. In Idaho Falls, creosote derivatives were found in the groundwater under a pole treating facility. An extensive monitoring and investigation program is underway. Arsenic has been found in the groundwater near a fertilizer manufacturing plant in Pocatello. Petroleum products, solvents and heavy metals have been detected in the groundwater at a railcar maintenance facility in Pocatello.

The above-mentioned examples are in no way intended to be a comprehensive list. Other documented areas of groundwater contamination do exist, and certainly new problems will be reported in the future.

TYPES AND SOURCES OF CONTAMINATION

Because groundwater flow is essentially laminar (nonturbulent), contaminants tend to follow generalized flow lines. Contaminant plumes elsewhere in the country have been traced several miles from their point of origin. The size and shape of the plume depends on the geologic framework, groundwater flow patterns, the type and concentration of contaminants and the rate of contaminant leaching.

The mobility of groundwater contamination is determined by the velocity of groundwater (typically only a few feet per day), the solubility of the contaminant and the physical and chemical characteristics of the aquifer. Some compounds, such as nitrates, are extremely soluble and can be very mobile. Other factors which affect the quality of water used for drinking water supplies are total dissolved solids, microbial pathogens, organic chemicals, inorganic compounds, metals, and radionuclides.

Total Dissolved Solids

Dissolved solids are a result of total mineral content in water. Dissolved solids consist mainly of the cations (calcium, magnesium, potassium and sodium) and anions (bicarbonate, carbonate, chloride, fluoride, nitrate and sulfate), plus silica (Parliman, et al. 1980). Total dissolved solids greater than 500 milligrams per liter (mg/l) are not recommended for drinking water.

Water hardness is caused mainly by calcium and magnesium dissolved in water. Hardness is expressed in mg/l of calcium carbonate ($CaCO_3$). Hardness is a measure of the soap consuming potential of water. Calcium and magnesium react with soap to form precipitates of calcium and magnesium. After the reaction is complete, the remaining soap is available to produce lather. Hardness in domestic water is generally not objectionable at concentrations of less than 100 mg/l (Parliman, et al. 1980). Hard water is generally not a health problem but may create an economic problem is water softening is necessary.

Microbial Pathogens

Microbial contamination occurs from a variety of sources which include septic systems, leaking sewers, livestock and log yard waste. State drinking water standards set a maximum for coliform bacteria of less than 1 colony per 100 ml. of water. Public water systems regularly test for this microbe. The presence of coliform bacteria may mean that other microbial pathogens (e.g., giardia, salmonella and hepatitis) are present in the water supply.

Organic Chemicals

A multitude of organic chemicals has been synthesized for home, industry and agriculture use. There are thousands in use today with more being added each year. Unfortunately there are no adopted drinking water standards for most organic chemicals. Toxic compounds are present in products used at home as well as industrial applications. Table 1 lists some of the toxic compounds found in commonly-used products. The EPA has set a maximum drinking water concentration of 5 ppb for some compounds (e.g., benzene). To put this in perspective, one ounce of benzene will degrade 3,125,000 gallons of water to a level of 5 ppb. Hazardous wastes are defined on the basis of ignitability, corrosivity, reactivity and toxicity. Contamination of groundwater by toxic or hazardous chemicals has been reported nationwide and has caused the closing of both public and private wells.

TABLE 1
TOXIC OR HAZARDOUS COMPONENTS OF COMMON PRODUCTS

Product	Toxic or Hazardous Components
Antifreeze (gasoline or coolant systems)	Methanol, ethylene glycol
Automatic transmission fluid	Petroleum distillates, xylene
Battery acid (electrolyte)	Sulfuric acid
Degreasers for driveways and garages	Petroleum solvents, alcohols, glycol ethers, chlorinated hydrocarbons, tuluene, phenols, dichloroperchloro-ethylene
Engine and radiator flushes	Petroleum solvents, ketones, butanol, glycol ethers
Hydraulic fluid (including brake fluid)	Hydrocarbons, fluorocarbons
Motor oils and waste oils	Hydrocarbons
Gasoline and jet fuel	Hydrocarbons, benzene, tuluene, xylene
Diesel fuel, kerosene, #2 heating oil	Hydrocarbons
Other petroleum products: grease, lubes	Hydrocarbons
Rustproofers	Phenols, heavy metals
Carwash detergent	Alkyl benzene sulfonates
Asphalt and roofing tar	Petroleum distillates, hydrocarbons
Paints, varnishes, stains, dyes	Heavy metals, toluene
Paint and lacquer thinners	Acetone, benzene, toluene, butyl acetate, methyl ketones
Paint and varnish removers, deglossers	Methylene chloride, toluene, acetone, xylene ethanol, benzene, methanol
Paint brush cleaners	Hydrocarbons, toluene, acetone, methyl ethyl ketones, methanol, glycol ethers
Floor and furniture strippers	Xylene
Metal polishes	Petroleum distillates, petroleum naptha, isopropanol
Laundry soil and stain removers	Petroleum distillates, tetrachloroethylene
Spot removers and dry cleaning fluids	Hydrocarbons, benzene, trichloroethylene, 1, 1, 1 trichloroethylene
Other cleaning solvents	Pure strength benzene, acetone
Rock salt (halite)	Sodium concentration
Refrigerants	1, 1, 2 trichloro- 1, 2, 2 trifluoroethane
Bug and tar removers	Petroleum distillates, xylene
Household cleaners, oven cleaners	xylene glycol ethers, isopropanol

TABLE 1 (CONCLUDED)

Product	Toxic or Hazardous Components
Drain cleaners	1, 1, 1 trichlorethane
Toilet cleaners	Xylene, sulfonates, cholorinated phenols
Cesspool cleaners	Tetrachloroethylene, dichlorobenzene, methylene chloride
Disinfectants	Cresol, xylenols
Pesticides (insects, weeds, rodents)	Naphthalene, Phosphorus, xylene, chloroform, heavy metals, chlorinated hydrocarbons
Photochemicals	Phenols, sodium sulfite, cyanide, silver halide, potassium bromide
Printing ink	Heavy metals, phenol-formaldehyde
Wood preservatives	Pentachlorophenols, creosote, copper, arsenic, chromium
Swimming pool chlorine	Sodium hypochlorate
Lye or caustic soda	Sodium hydroxide
Jewelry cleaners	Sodium cyanide
Leather dyes	Formic acid
Fertilizers	Arsenic, nitrates, ammonium, sulfuric acid, heavy metals, formaldehyde, phosphoric acid, chlorinated hydrocarbons

Inorganic Chemicals

Concern over health effects of inorganics has focused on concentrations of nitrate and heavy metals such as mercury, lead and cadmium. One of the major contributors to heavy metal contamination is from mining wastes. Nitrate (NO_3 as N) is the end product of the aerobic stabilization of organic nitrogen. Natural sources of nitrogen are minor contributors of nitrogen to most groundwater (Parliman, et al. 1980). The major contributors to nitrate contamination of groundwater include effluent from septic tank drainfields, excessive fertilizer application, and runoff from feedlots and dairies.

Radionuclides

Radionuclides occur naturally at extremely low levels in groundwater. Concentrated radioactive wastes are a result of the nuclear industry. The only area in Idaho where possible concern exists over radiation contamination from man-made sources is at the INEL or from a possible accident through transport.

Of increasing concern nationwide is the presence of radon in groundwater. Radon is a naturally occurring radionuclide that occurs as a decay product in uranium bearing rocks. Granites or gravels derived from granites are the chief source, although black shales may also be contributors. The

Rathdrum Prairie in northern Idaho is known to be radon bearing. Currently, it is thought that the major risk from radon bearing water is the release of radon gas during water use in homes (e.g., showering).

SOURCES OF CONTAMINATION

The following activities have been identified as potential sources of contamination in Idaho:

A. Contaminants discharged onto or into the ground for treatment or disposal:

   1. Land spreading of industrial and municipal wastewater treatment plant sludge and septage.

   2. Land applied wastewater from municipal and industrial sources.

   3. Injection wells.

   4. Septic tank systems.

   5. Landfills.

B. Storage of contaminants:

   1. Pits, ponds and lagoons.

   2. Underground storage tanks.

   3. Mine tailings.

C. Surface activities which may result in groundwater pollution:

   1. Feedlots and dairies.

   2. Agricultural activities.

   3. Chemigation.

   4. Surface runoff from urban and transportation routes.

   5. Hazardous materials (use, transportation and storage).

D. Activities which may provide direct access to aquifers:

   1. Well drilling.

   2. Injection wells.

   3. Dry wells/surface runoff.

   4. Geothermal wells.

   5. Overpumping.

6. Mining and ore processing.

E. Transportation:

1. Oil and gas pipelines.

2. Surface transportation of contaminants

Contaminants Discharged for Treatment or Disposal

Land treatment, when properly used, can be an effective method of disposing of wastewater from septic systems and municipal sludge by-products of food processing plants. By using proper application rates, this material can be an effective organic fertilizer. Improper design or operation of these activities allows contaminants to reach the groundwater table. Drain fields utilize the aerobic activities and filtration effects of soil to treat effluent. Injection wells are principally designed to dispose of excessive irrigation tailwater or storm runoff. When improperly designed or operated, this practice may result in a direct path of contaminants to the aquifer.

Storage of Contaminants

Waste storage or bulk disposal (permanent storage) of materials containing contaminants poses a serious threat to groundwater. Burial of wastes has long been the accepted practice for disposal. Leaching of contaminants from landfills, mine tailings, underground storage tanks or surface lagoons poses a serious threat to groundwater. As water percolates through this material, it picks up contaminants present and transports them to the water table. In some cases, these activities are located within the water table or seasonal water table.

Surface Activities Which May Result in Groundwater Pollution

Agriculture activities in the form of pesticide and fertilizer application, if not properly conducted, may result in contaminants reaching the water table. Feedlots are also a source of concentrated contaminants which may pose serious runoff problems. Urban runoff is widely recognized as another serious threat to groundwater quality. Toxic substances on streets as a result of urban activity (e.g., antifreeze, oil, gasoline, heavy metals and pesticides) are washed into storm sewers and may reach the water table through dry wells or settling basins. Improper use handling, storage and disposal of hazardous materials may enter groundwater through infiltration of spills or runoff into drywells. Landfills also provide a source of groundwater contamination.

Activities Which May Provide Direct Access to Aquifers

Water wells or geologic exploration wells provide access to the aquifer. Abandoned wells and wells with lack of surface seals both provide runoff with direct access to the aquifer. Underground mining operations are frequently backfilled with mill tailings which contain a multitude of contaminants. Overpumping of water supply wells can locally change the direction of groundwater movement.

Transportation

Accidental spills during transport pose potential groundwater threats. Leaking sanitary sewer lines create localized areas of extreme contamination. Similarly, oil and gas pipelines can leak resulting in contamination.

GROUNDWATER VULNERABILITY

Human activities are usually the source of contamination, but natural conditions make some areas more susceptible to contamination that others. Geologic nature and thickness of the unsaturated zone are critical factors in determining how fast and what percentage of contaminants will reach the water table. As water percolates through the soil horizon, the amount of silts and clays present will determine the rate of percolation and the percent of runoff. Certain clays have a high cation exchange capacity and will, therefore, retain some of the contaminants.

Finer-grained materials in the unsaturated zone are more effective in protecting underlying aquifers than coarse materials. Water moves more slowly in finer materials so there is more time for pollutants to be reduced in concentration before reaching the aquifer. Finer materials will also filter the passing water. Where the unsaturated zone consists of coarse materials or fractured bedrock, the water moves much faster and little attenuation or filtration occurs.

Unconfined aquifers are generally much more susceptible to contamination than confined aquifers. A confined aquifer is protected by one or more overlying low permeability layers. Generally, an unconfined aquifer has no protective layer and is, therefore, more vulnerable to contamination.

The geology of the aquifer is a critical factor in determining how far and how fast a contaminant will travel once it reaches the groundwater table. The attenuation capacity of fine-grained aquifers is greater than coarse-grained aquifers. Aquifers formed in basalt have little or no filtration or attenuation effects. Water in these aquifers moves through an interconnecting network of fractures and lava tubes.

The volume of recharge water transmitted to an aquifer varies depending upon location. Frequently, high recharge areas have high precipitation and a highly permeable soil and unsaturated zone. Because high recharge areas transmit more water to the aquifer, they also have the capability to transmit more contaminants to the aquifer. Sources of contaminants in high recharge areas have a much greater potential for aquifer contamination than in low recharge areas.

Pursuant to Section 39-105, of the Idaho Environmental Protection and Health Act, the Director of the Department of Health and Welfare is directed to formulate and recommend to the Board of Health and Welfare, such rules and regulations and standards as may be necessary to deal with the problems related to personal health and water pollution. The Director is further charged with the supervision and administration of a system to safeguard the quality of the waters of the state. Authority to adopt rules, regulations and standards as are necessary and feasible to protect the environment and health of the citizens of the state is vested in the Board of Health and Welfare pursuant to Section 39-107, Idaho Code. In 1985, the Idaho Division of Environmental Quality, Bureau of Water Quality, was designated by the Governor as having lead responsibility for groundwater quality protection within Idaho. Idaho’s groundwater quality management program combines the various federal laws with state developed rules, regulations and programs. This approach is designed to develop a program which is specific to the needs of the State of Idaho.

FEDERAL LAWS

The Safe Drinking Water Act

The Safe Drinking Water Act provides several methods for protection of groundwater quality. The Act specifically requires the U.S. Environmental Protection Agency to establish regulations for the control of underground injection wells. The Act also establishes the procedures to develop, implement and assess demonstration programs to protect sole or principal source aquifers. Last, the Governor of each state is to adopt and submit to the EPA a state program to protect wellhead areas within their jurisdiction within three years of enactment of the Amendments. However, Congress has failed to fund the Sole Source Aquifer and Wellhead Protection programs at this time. The Act also required EPA to establish maximum contaminant level goals and maximum contaminant levels for 83 drinking water contaminants. The Volatile Organic Chemical standards will be effective in January 1989, and require the states to determine vulnerability to contamination of water supply systems in order to develop a contaminant monitoring strategy. System vulnerability will be determined based upon a number of factors including the current status of groundwater contamination and the potential for such contamination. As more of the drinking water contaminant standards are established, the states will be required to conduct additional system assessments for vulnerability and develop method to protect the drinking water sources. This will be particularly important in Idaho where a great majority of our drinking water systems use groundwater sources.

The Clean Water Act

The basic goal of the Clean Water Act (CWA) is to restore and maintain the chemical, physical and biological integrity of the nation's waters. EPA provides grants to states for development and implementation of state Groundwater Protection strategies. Under the CWA's nonpoint source authorities, EPA also provides financial assistance to states for nonpoint source monitoring/assessments, planning, program development and demonstration projects. Suction 319 of the CWA requires states to assess impacts from non-point source pollution and develop abatement programs. This section authorizes federal funding to support this program; however, Section 319 appropriations have not yet been made by Congress. Through the assistance of an advisory committee, the Idaho Non-Point Source Status Report and Assessment will be completed in early 1989. Under Section 520 of the CWA, the EPA is directed to fund studies to identify existing and potential point and nonpoint sources of pollution for the Spokane Valley-Rathdrum Prairie Aquifer and identify measures to control such pollution.

The Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA), originally passed in 1976, regulates the management of active hazardous and solid waste treatment, storage and disposal facilities (e.g., tanks, lagoons, landfills). Permits issued under RCRA specify concentration limits in groundwater which, if exceeded, trigger corrective action to remediate the release of hazardous wastes from a facility. These corrective actions must meet RCRA requirements and are overseen by RCRA authorities. Hazardous constituents must comply with RCRA groundwater protection standards based on one of the following: background levels, maximum contaminant levels (MCLs) as set by the Safe Drinking Water Act, or alternate concentration limits (ACLs). New regulations are added frequently. To protect against groundwater contamination, requirements for RCRA permits can include the installation of monitoring wells, liners, leachate collection systems and special containment systems.

Superfund

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund), passed into law in December 1980, is principally concerned with the cleanup of toxic releases from uncontrolled or abandoned hazardous waste sites. The program identifies and investigates sites where releases of hazardous substances into the environment might have occurred. Sites that score high enough through the Hazardous Ranking System are put on a National Priorities List (NPL) and are eligible for cleanup under Superfund. Even if a site is not on the NPL but poses an immediate threat to public health or the environment, it can be cleaned up through a CERCLA emergency removal action.

The Superfund Amendments and Reauthorization Act (SARA), signed into law in October 1986, is a five year extension of the Superfund program. SARA also creates a separate fund for cleanup of leaking underground storage tanks containing petroleum. An important part of SARA is Title III which deals with emergency planning and community right-to-know. Title III is an innovative approach to chemical and emergency management and mitigation. SARA

Title III is a mandate to state and local governments to become aware of potential chemical hazards, to increase their preparedness for incidents involving hazardous substances and to provide access to chemical information.

DIVISION OF ENVIRONMENTAL QUALITY REGULATIONS, STANDARDS, GUIDELINES AND PROGRAMS

Idaho Water Quality Standards and Wastewater Treatment Requirements

Provisions are set forth by these regulations for protection of designated water uses and the establishment of water quality standards that will protect these uses. Restrictions are outlined by those regulations for control of point source and non-point source discharges and other activities that may adversely affect the waters of the State of Idaho, including surface and groundwater.

Groundwater Quality Management Plan for Idaho

The Groundwater Quality Management Plan for Idaho (1983, updated 1985, with additional revisions due in 1989) provides the basis for future comprehensive groundwater quality planning. This plan describes the major groundwater systems in Idaho, makes an assessment of groundwater quality, identifies the major sources of potential contamination and prioritizes the pollution potential of Idaho’s major aquifers and identifies additional programs that are necessary for groundwater quality protection. This ongoing planning process guides the development and implementation of Idaho’s groundwater quality protection program. The 1989 version will have a strong emphasis on interagency coordination.

Groundwater Policies and Standards System

The proposed groundwater policy and standards system are intended to provide a basis for statewide groundwater quality protection by:

1. Identifying the appropriate beneficial uses of state groundwater;

2. Providing minimum criteria and procedures to classify and protect groundwater for appropriate beneficial uses; and

3. Providing consistency among existing regulatory programs which address activities which are likely to affect the quality of the groundwater of the state.

Public hearings on the proposed groundwater standards were held in November 1987. In response to a recommendation by the hearing officer, an advisory committee consisting of interested industries, agencies and legislators has been formed to assist DEQ in finalizing the standards.

During the 1988 Legislature, Senate Concurrent Resolution 129 was passed creating an interim legislative subcommittee on groundwater. In June, the subcommittee requested that the Department delay further work on the groundwater standards to allow the subcommittee the opportunity to evaluate state groundwater policy. The subcommittee has held several meetings around the state to obtain input and will report to the 1989 Legislature regarding policy and any necessary groundwater statutes.

Nonpoint Source Management Program

Section 319 of the Federal Water Quality Act of 1987 requires states to assess nonpoint source impacts on groundwater and to develop a management program to address these impacts. Through the assistance of an advisory committee, the assessment was published in draft in May 1988, the final report is due to be published in early 1989. Agriculture, septic systems and urban runoff were identified as the highest priority sources. The groundwater advisory group is currently drafting the 4-year management program. Monitoring and improved management practices are the primary components.

Idaho Regulations for Public Drinking Water Systems

The purpose of these regulations is to control and regulate the design, construction, operation, maintenance and quality control of public drinking water systems and to provide a degree of assurance that such systems are protected from contamination and maintained free of contaminants which may injure the health of the consumer. Table 2 lists the parameters required for analysis in Idaho.

TABLE 2
PRIMARY DRINKING WATER STANDARDS

SUBSTANCE	MAXIMUM ALLOWABLE CONCENTRATIONS MG/L
Arsenic	0.050
Barium	1.000
Cadmium	0.010
Chromium	0.050
Cyanide	0.200
SUBSTANCE	MAXIMUM ALLOWABLE CONCENTRATIONS MG/
Fluoride	4.000
Lead	0.050
Mercury	0.002
Nitrate (as N)	10.000
Selenium	0.010
Silver	0.050
Sodium	No maximum – 20 suggested as an optimum

TABLE 2 (Continued)

SECONDARY QUALITY STANDARDS

CHARACTERISTIC	LIMIT	CHARACTERISTIC	LIMIT
pH	6.5-8.5	Iron	0.3 mg/l
Temperature	80° F.	Manganese	0.05 mg/l
Color	15 Units	Phenols	0.001 mg/l
Threshold odor number	3	Sulfate	250 mg/l
Foaming Agents	0.5 mg/l	Total Dissolved Solids	500 mg/l
Copper	1 mg/l	Zinc	5 mg/l
Chloride	250 mg/l		
Hydrogen Sulfide	0.05 mg/l		

ORGANIC CHEMICALS	MAXIMUM LEVEL MG/l
Endrin (1, 2, 3, 4, 10, 10-hexachloro-6,7 epoxy-1, 4, 4a, 5, 6, 7, 8, 8a-octahydro-1,4 endo, endo-5, 8-dimethano naphthalene)	0.0002
Lindane (1, 2, 3, 4, 5, 6-hexachlorocyclo-hexane, gamma isomer)	0.004
Methoxychlor (1,1,1-Trichloro-2,2-bis [p-methoxyphenyl] ethane)	0.1
Toxaphene ($C_{10}H_{10}Cl_8$ Technical Chlorinated camphene, 67-69 percent chlorine)	0.005
2,4-D (2,4-Dichlorophenoxyacetic acid)	0.1
2,4,5-TP silvex (2,4,5-Trichloro-phenoxypropionic acid)	0.01

RADIOCHEMICALS

Gross Alpha

Combined radium-226 and radium-228 shall not exceed 5 pCi/l

Gross alpha particle activity shall not exceed 15 pCi/l. Includes radium -226 but excluding radon and uranium.

More information regarding maximum contaminant levels of radiochemicals in public drinking waters may be found in the Idaho Regulations for Public Drinking Water Systems.

TABLE 2 (Concluded)

VOLATILE ORGANIC CHEMICALS (VOCs)*

VOC	MCL (mg/l)	VOC	MCL (mg/l)
Trichloroethylene	0.005	Benzene	0.005
Carbon Tetrachloride	0.005	para-Dichlorobenzene	0.075
Vinyl Chloride	0.002	1,1-Dichloroethylene	0.007
1,2 - Dichloroethane	0.005	1,1,1-Trichloroethane	0.2

* Adopted under the Safe Drinking Water Act, July 1987.

Source: Idaho Regulations for Public Drinking Water Systems, 1985.

Underground Storage Tank Regulations

The final federal regulations covering Underground Storage Tanks (USTs) that contain petroleum or hazardous chemicals were issued in September 1988. Approximately 10,000 tanks in Idaho will be regulated under this program.

Roughly 90 percent of Idaho's drinking water is groundwater. Organic chemicals and gasoline and other petroleum products are among the contaminants most frequently found in groundwater. The chemicals that make up gasoline (such as benzene and toluene) are among the most toxic of commonly found chemicals.

The Bureau of Water Quality, being the designated state agency to work with the EPA on the UST program, is evaluating possible program implementation options. The Bureau put together an UST Technical Advisory Committee (TAC) of affected parties to help provide input on these options. Since it is expected that EPA will not be providing financial support to those directly impacted by the program, the Bureau and TAC will be evaluating several alternatives to help with this problem.

Underground Storage Tank Trust Fund

In 1986, Congress amended Subtitle I of the Resource Conservation and Reclamation Act (RCRA) of 1976 to provide for a federal Trust Fund (UST Trust) to the states for the cleanup of sites contaminated with petroleum from leaking underground storage tanks. A program for administering Idaho's UST Trust Fund was developed in 1988. Several necessary policies have been drafted (Quality Assurance, Public Participation, Safety, Contractor Oversight, Cost Recovery and Corrective Action) to administer the program. A state interest-earning trust fund account is being created for deposit of cost-recovered funds. Cost-recovered funds will be applied to other leaking UST petroleum contaminated sites.

Site investigations and cleanups financed with UST Trust Fund monies are usually contracted to hydrogeologic/engineering consultant firms. An initial list of sites requiring UST Trust Fund financed investigations and cleanups was developed in the summer of 1988. UST Trust Fund activities at these sites will be initiated in the fall of 1988.

Future UST Trust Fund activities will include the development of soil, groundwater and surface water cleanup criteria for sites contaminated with petroleum from leaking USTs. As more leaking UST sites are discovered, they will be prioritized according to their potential threat to public health and environment.

On-Site Sewage Disposal Program

The Idaho Rules and Regulations for Individual and Subsurface Sewage Disposal Systems govern the permitting, design, construction and operation of septic systems. These regulations were updated in 1985. Future regulation changes are planned and will probably include a section on large soil absorption systems and increased licensing and training requirements for installers of alternative systems.

The septic system program is administered by the seven health districts. Technical support for this program is provided by the DEQ through a septic system coordinator and a Technical Guidance Committee. The Technical Guidance Committee is responsible for maintaining a manual which includes state of the are concepts in the design and construction of alternative septic systems and guidance to assist in site evaluation.

Regulations for Land Applied Wastewater

In October of 1987, the State of Idaho Board of Health and Welfare promulgated regulations including a permitting system, which went into effect April 1, 1988, for land application of waste water. These regulations will address groundwater contamination problems related to this type of wastewater treatment.

In principle, the land treatment process utilizes soil and vegetation to remove potential pollutants from applied wastewater. However, in some cases, ground and surface water pollution related to system operation have resulted.

The regulations and supporting guidelines were developed by a Technical Advisory Committee which included representation from the industrial and municipal wastewater treatment sector. It is expected that as many as 100 permits will be issued by the April 1, 1989, permit deadline.

Rules Governing Ore Processing by Cyanidation:

The provisions of these regulations establish requirements for water quality protection which address performance, construction, operation and closure of that portion of any ore processing facility that is intended to contain, treat or dispose of process water or process contaminated water containing cyanide.

Guidelines for Land Application of Municipal Sewage Sludge

This document provides technical guidance for the land application of municipal sludge in order to protect the quality of the waters of the State of Idaho.

Idaho Waste Management Guidelines for Concentrated Animal Feeding Operations

These guidelines are designed to protect water quality by helping owners and operators of confined animal feeding operations develop and adopt an animal waste management system by choosing the best management practices suited to their needs. Consideration of groundwater is minimal and should be expanded in the future.

Hazardous Materials

The Bureau of Hazardous Materials of the DEQ is charged with protecting the environment from contamination by hazardous wastes. The Federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund) became law in 1980 and was amended in 1986 (the Superfund Amendment and Reauthorization Act or SARA). Superfund provides the means to pay for the cleanup of hazardous waste sites when the responsible parties cannot be found or are unwilling or unable to clean up a site. It also provides the Environmental Protection Agency (EPA) with the authority to take legal action to force responsible parties to clean up sites or to pay back the federal government for the cost of the cleanup. The Hazardous Materials Bureau investigates and ranks sites under the Hazardous Ranking System as well as overseeing the process of cleaning up sites that have scored high enough to be eligible for cleanup. The Hazardous Materials bureau also administers the Resource Conservation and Recovery Act (RCRA, 1976, reauthorized 1984) provides the EPA with authority to establish a program to track hazardous waste from generation through transportation, treatment, storage, and disposal, and is seeking authorization to adopt a state managed RCRA program. The Idaho Hazardous Waste Management Act (1983) provided the State of Idaho with the equivalent authority of RCRA Subtitle C to regulate hazardous waste in Idaho. The Idaho Hazardous Waste Management Act improves the Bureau's ability to prevent groundwater impacts and expands its authorities for remediation of existing contamination. SARA, Title III (community right to know), is being implemented through the State Emergency Response Commission. This program emphasizes prevention and response to hazardous materials through local planning.

Idaho Solid Waste Management Regulations

These regulations provide standards for the management of solid wastes to minimize the detrimental effects of disposal. An updated version of these regulations is currently being written to reflect groundwater quality concerns. The EPA is proposing new regulations for landfills under RCRA Subtitle D, which will address monitoring for an expanded list of contaminants and improved practices for final closure of existing landfills.

Idaho Hazardous Waste Management Act

Under this Act, hazardous waste treatment, storage and disposal facilities must obtain permits from the Department of Health and Welfare. Permit requirements are specified for solid waste management units, containers, tanks, surface impoundments, waste piles, landfills and other types of facilities. Groundwater monitoring and protection, operational requirements, and closure and post-closure plans must be permitted. The Hazardous Waste Management Plan, including facility siting requiremenst, was developed to implement this Act.

Technical Support on Groundwater Programs

A staff hydrogeologist, soil scientist, and a consultant for the subsurface sewage disposal program provide technical assistance to both the Division of Environmental Quality field offices and the District Health Departments.

Public Information and Program Coordination

This ongoing program is accomplished through advisory committees, public information brochures, articles in the Clean Water Newsletter, presentations at citizen groups and organizations, and the promotion of local groundwater quality programs. At present, DEQ is coordinating six different advisory committees which have been formed to provide input on groundwater program development and to assist in effective implementation of regulations. These committees provide a vital link to the other state agencies, regulated public, and interested citizens.

Groundwater Vulnerability Assessment

Groundwater vulnerability varies from area to area and is dependent on such factors as depth to water, soil type, recharge rate and topography. The DEQ in cooperation with the Idaho Department of Water Resources and the U.S. Geological Survey has begun a groundwater vulnerability mapping project. A vulnerability rating is assigned and plotted on maps. This program is currently in progress for the Eastern Snake River Plain Aquifer and will eventually be expanded to include the entire state. As these are computer-generated maps, this program can be expanded to include other groundwater program areas (e.g., underground storage tank program, wellhead protection and agricultural chemicals management).

Groundwater Quality Monitoring

A limited monitoring program is funded for known or suspected areas of degraded groundwater quality. Extensive monitoring is limited due to lack of funding. The magnitude of impact of most potential sources of groundwater contaminants is poorly defined in the Snake Plain Aquifer because monitoring data is very limited. Data on organic contaminants and pesticides are virtually non-existent.

Groundwater Contamination Log

The contamination log is used to track groundwater contamination incidents throughout the state. Annual summaries are published by DEQ.

OTHER STATE AGENCIES WHICH HAVE ROLES IN GROUNDWATER QUALITY MANAGEMENT:

District Health Departments

A network of District Health Offices performs some groundwater protection functions, including inspection of sanitary landfills and the siting of subsurface sewage disposal systems. The District Health Departments also provide program activities relating to private and some public drinking water supplies.

Department of Water Resources

The Department of Water Resources is charged with administering well construction standards and licensing well drillers under Section 42-238 of the Idaho Code. Since 1987, the Idaho Code has required that a drilling permit be submitted by the well owner and approved by the Department for all wells drilled in Idaho. From July 1, 1987, to June 30, 1988, approval was granted for 1,979 drilling permits and 1,858 well driller reports were received for the entire state. It is estimated that from 1,500 to 2,000 wells are drilled yearly. This includes domestic stock, irrigation and other wells.

Well contamination can result from improper sealing around the well casing and from spills or the improper use of drilling materials during construction. The rules and regulations for well construction charges the driller with proper handling of the construction materials and the proper sealing of the wells.

Another potential concern involves failure of the driller to isolate deep from shallow aquifers. Mixing of water from several aquifers can have deleterious impacts on water quality. This problem has been addressed in the rules adopted by the Water Resources Board in August 1988.

The IDWR has state primacy for the Underground Injection Control (UIC) program. Injection wells in use fit primarily into two classes, irrigation disposal wells (federal Class VF-1) and storm water runoff wells (federal Class VD-2). Agricultural injection wells are generally deep wells (greater than 18 feet in vertical depth), require permits from IDWR to operate, and are periodically monitored to determine the quality of injected fluids. Storm water drainage wells are used to inject storm runoff from streets, highways, airports and parking lots. Just over 45 percent of these drainage wells are deep wells, and must be authorized by permit, while the remaining are shallow injection wells (less than or equal to 18 feet in depth). Shallow injection wells are authorized without permit provided that required inventory information is furnished and use of the well does not result in contamination of a drinking water source or endangerment of other beneficial uses.

Department of Agriculture

The Department of Agriculture provides technical assistance or agricultural chemicals, regulates pesticide application and waste handling and assists in designing monitoring studies.

Department of Lands

The State Land Board functions as the Oil and Gas Commission. The department administers regulations governing the issuance of geothermal resource leases.

County and Local Programs

Groundwater quality studies and programs have been conducted in various counties including Bannock, Bingham, Minidoka, Fremont, Ada and the panhandle area. The Panhandle Health Department has an ongoing groundwater quality management program. Program accomplishments include innovative sewage management agreements and other measures designed to protect groundwater quality.

The University of Idaho

The University of Idaho, Water Resources Research Institute, performs studies on groundwater quality and quantity.

FEDERAL AGENCIES WHICH HAVE ROLES IN GROUNDWATER QUALITY MANAGEMENT:

Environmental Protection Agency

The Environmental Protection Agency (EPA) Office of Groundwater in Seattle and the Idaho Operations Office in Boise provide financial support through grant assistance to the Idaho Division of Environmental Quality. As a part of this financial assistance, the EPA provides administrative overview and support for the state's groundwater quality management programs. Additionally, the Boise EPA office provides administrative oversight of Idaho hazardous waste and underground storage tank programs. Technical assistance is provided by the EPA through a staff hydrogeologist. Those areas which have been designated as sole source aquifers have an additional level of EPA review. Such review is only for federal financially assisted projects which have potential to impact the quality of groundwater.

In 1984, EPA published a groundwater protection strategy (EPA, 1984). This strategy includes four major components: 1) a strengthening of states' groundwater protection programs; 2) an assessment of contaminant problems, particularly underground storage tanks, surface impoundments and landfills; 3) guidelines for EPA decisions affecting groundwater protection and cleanup; and 4) a strengthening of EPA's groundwater management programs and increased federal-state cooperation. In this strategy, the EPA intends that state and local governments assume primary responsibility for groundwater quality protection. Under the EPA's proposed groundwater classification system (released in draft form in 1986), three classes of groundwater are proposed to ensure that the most appropriate beneficial use is maintained for all groundwaters.

Currently the EPA is developing a pesticide strategy to prevent unacceptable contamination of current and potential drinking water supplies. The state mapping of groundwater vulnerability will play a key role in developing a statewide pesticide strategy. The EPA is also currently conducting a national pesticide survey to assess the current level of pesticide contamination in groundwater.

U.S. Department of the Interior

The U.S. Geological Survey has conducted a regional aquifer system analysis (RASA) for the Snake Plain Aquifer. This study defined the hydrology, geochemistry and groundwater quality for the regional aquifer. The USGS has also conducted numerous studies on groundwater quality and quantity at other locations in Idaho.

The U.S. Bureau of Land Management is involved in a study to assess the effects of some agricultural practices on groundwater quality. The U. S. Bureau of Reclamation performs some site specific groundwater quality and quantity monitoring.

U.S. Department of Agriculture

The University of Idaho Cooperative Extension Service includes groundwater quality topics in pesticide applicator and grower training programs. The Soil Conservation Service (SCS) provides conservation planning assistance to all land users through the local soil and water conservation districts. SCS is presently developing a Water Quality Action Plan to fully develop resource management system standards for their field office technical guides. Those standards will be established to fully integrate surface and groundwater quality into the conservation planning process. The SCS is also providing soils data for the groundwater vulnerability assessment.

Each jurisdiction should formulate the groundwater quality management goals which are best suited to the local aquifer and degree of groundwater protection required. The most useful and cost-effective methods involve preventative techniques. Preventative actions, both regulatory and nonregulatory, implemented by local jurisdictions can be an effective method of protecting the quality of the groundwaters of Idaho. Prevention of contamination is necessary to maintain an adequate supply of groundwater for drinking, industrial and agricultural uses.

In some states, locally developed programs working in conjunction with statewide programs have proven to be an effective method of managing groundwater quality. For example, county and municipal ordinances controlling underground storage of gasoline were in place in Cape Cod, Massachusetts; Long Island, New York; Dade County, Florida; and Santa Clara County, California one to five years before state or federal laws were enacted.

Almost every human activity has some potential for contaminating groundwater. The degree of risk depends on the sensitivity of the aquifer to contamination and the type and magnitude of the potential contaminant. Although a specific area may not have a known groundwater contamination problem, preventative action is the best option currently available to ensure acceptable groundwater quality. By combining land use awareness with the state and federal source control programs, groundwater quality may be effectively managed.

The first step toward managing groundwater quality on the local level is to develop a comprehensive groundwater quality plan. Comprehensive planning is a process local governments use to direct the future of their community in an orderly manner. In comprehensive planning, the process of identifying community goals and objectives is essential before specific management techniques can be selected and implemented. A groundwater quality management program would typically identify what needs to be protected, what degree of protection is required and how this protection will be accomplished. Groundwater protection will vary from jurisdiction to jurisdiction. An urban area which is dependent on community supply wells may be most concerned about protecting their present and future well fields. A rural area that relies on individual shallow wells may design a program aimed at protecting groundwater quality through the aquifer. Implementation of groundwater quality comprehensive plans may be achieved through both nonregulatory and regulatory programs. The Panhandle Health Department has taken an active role in northern Idaho in protecting groundwater quality through innovative sewage management agreements, educational activities and interagency cooperation.

NONREGULATORY

Public Education

Public education is an important aspect of every program. By promoting public awareness, both voluntary and regulatory programs become more effective. It is important for the public to realize how human activity affects groundwater quality. Education can help overcome opposition to protection programs. An alert and informed public will be helpful in supporting and assisting monitoring and enforcement programs. Education will enhance the public acceptance of these programs and make the public cognizant of proper disposal techniques of hazardous and toxic products. The Panhandle Health District, in cooperation with Spokane County, Washington, has developed public information brochures which offer alternatives to and proper disposal of hazardous products commonly used in home and garden situations.

Household Hazardous Waste Collection Days

There are a variety of hazardous and toxic compounds present in common household products (Table 1, page 13). The disposal of unwanted portions of these products is generally a matter of convenience. Even small quantities of these products which are sent to the landfill or poured down the sewer or septic tank have the ability to contaminate groundwater supplies. A collection center can be provided where citizens can bring unused portions of hazardous products. The Hazardous Materials Bureau has been acting as an information center in Idaho to prepare for collection days and has provided communities statewide with detailed information on how to conduct these collection days.

Best Management Practices

Best management practices (BMPs) can be effective at addressing pollution from nonpoint sources such as urban areas, agricultural lands and forests. BMPs are recommended practices for engaging in activities that are likely to cause pollution over a large area. BMPs can be an effective tool for protecting groundwater because they offer technical guidelines that may be adopted which provide for a more environmentally sound operation. Examples of BMPs that reduce the pollution effects on groundwater include developing grassy swales to filter pollutants from urban runoff, minimizing the use of leachable pesticides and not overapplying fertilizers to lawns and crops.

Land Acquisition

Land acquisition, easements and open space preservation are other nonregulatory methods of reducing groundwater impacts. This can be an effective approach at protecting areas mapped as sensitive to contamination. Often such lands are used for parks and playgrounds. The cost of land acquisition makes this program most effective when small parcels are involved.

REGULATORY

Regulatory techniques are designed to protect groundwater quality by conformance to standards. Compliance with regulations is mandatory and, unless based on sound background information and well-explained, can be considered intrusive by citizens.

Zoning

Zoning is a land use restriction frequently used by local governments. Through an understanding of the local geology and hydrology, areas sensitive to groundwater contamination can be identified. A geohydrologic zoning overlay can then be created to protect groundwater supplies. Zoning can be used to restrict or prohibit activities that would endanger groundwater in sensitive areas. More importantly, conditional use permits can be used to require mitigation of contaminant sources in mapped sensitive areas. Zoning is being proposed in Tacoma, Washington, to prevent further contamination of an aquifer which provides up to 40 percent of the city’s water supply. An overlay zone would be applied to regulate development above the aquifer. The area involved includes some commercial and industrial uses which were found to be the major source of contamination. Special regulations would be imposed on users and handlers of toxic and hazardous materials within the overlay zone. There would be new permit requirements for hazardous material storage or handing facilities, new standards for construction of such facilities and additional on-site monitoring and inspection requirements.

Currently, over 90 percent of the cities and towns in Massachusetts have adopted zoning regulations, bylaws or Board of Health regulations to protect groundwaters. These include flood plain and wetland zoning, aquifer protection districts, toxic and hazardous materials controls and control of the underground storage of petroleum products.

Wellhead Protection

Wellhead protection programs develop techniques which protect recharge areas and the area surrounding a water supply well. A wellhead protection program can be used to supplement a zoning overlay. Land management programs need to address physical, microbial and chemical threats to groundwater within the defined zone of influence of community supply wells. Within this area of influence, groundwater velocities can increase dramatically. The area requiring additional protection around a well depends on the aquifer, the extent of pumping and the vulnerability to contamination. Management activities to protect groundwater in these area include regulation of land use through special ordinances and permits, prohibition of selected activities, and acquisition of land. By taking into account the local geology and hydrology, the upgradient side of the well can be identified and a more effective and less restrictive zone can be identified than defining an arbitrary protection radius. This method may also be utilized to restrict the placement of new community supply wells.

Dade County, Florida, has developed an ordinance which effectively protects the area of influence around a community supply well. Key provisions of the code include:

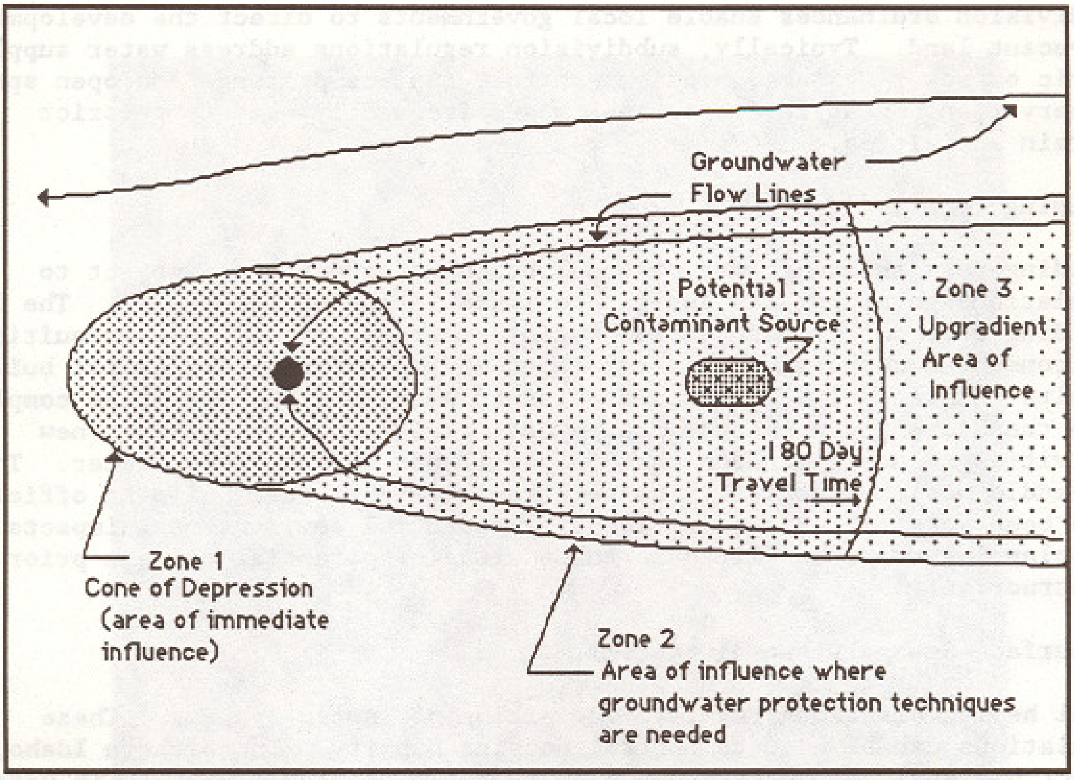
1. Prohibition of all hazardous materials within the average one-day pumpage area for supply wells. (Groundwater around a community supply well may move in excess of 100 feet/day.)
2. Connection of public sewers is required in the maximum protection area (defined as a 210-day travel time) if the nearest connection is within 100 feet of the property.
3. An operating permit is required for all land uses within the maximum protection area that will discharge treated waste water by any method other than a public sewer or that use, generate, handle, dispose of, discharge or store hazardous materials.
4. Septic systems are regulated according to travel time to the supply well according to the following schedule:

ZONE	MAXIMUM SEPTIC SYSTEM TANK LOADING (GALLONS/DAY/ACRE)
10-Day Travel	140
30-Day Travel	350
100-Day Travel	600
210-Day Travel	800
>210-Day Travel	1,500

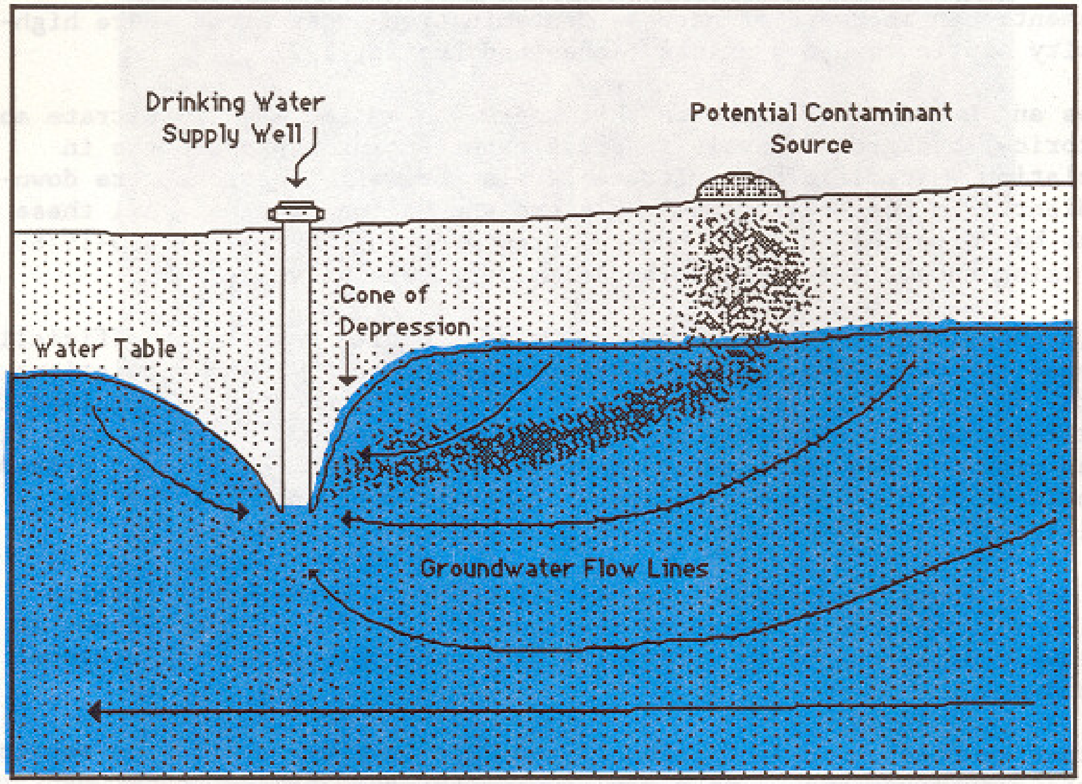
Figure 8 illustrates the area of influence around a hypothetical drinking water supply well. Zone I is described as the cone of depression or drawdown of the water table due to pumping. Groundwater velocities in this zone increase dramatically and may be as great as 100 feet/day. Maximum protection of groundwater from all potential contaminant sources is crucial in this zone. Zone II is typically defined as the upgradient area where contaminated groundwater will likely reach the well without appreciable dilution. This zone will vary depending on such factors as recharge rate, aquifer type and groundwater flow velocity. Restrictions in this zone may include prohibition of hazardous material use, generation, handling and storage, and mandatory sewer hookups where available. Zone three or the upgradient area of influence may be utilized for risk assessment (e.g., spill response) and siting criteria for large industrial operations (e.g., mandatory groundwater monitoring).

The State of Washington has developed a groundwater management area program to address similar concerns. Instead of protecting the area around a community supply well a local government may designate a part of an aquifer as a groundwater management area. The purpose of this program is to develop a comprehensive program for the designated area to assure groundwater quality for current and future uses.

Figure 8: Schematic Diagram Showing the Area of Influence Around a Drinking Water Well



Plan View



Cross-sectional View

Subdivision Ordinances

Subdivision ordinances enable local governments to direct the development of vacant land. Typically, subdivision regulations address water supply, septic or sewer systems, erosion control, surface drainage and open space preservation. Restrictive covenants are frequently used to restrict certain activities.

Building Permits

Building permits are issued by local building departments subject to regulations governing the design and installation of structures. The local building code can be amended to protect groundwater quality by requiring environmental compliance as a condition of the permit. Commercial building permits in the State of Washington are issued providing the permittee complies with the State Environmental Policy Act. This act requires that new activities be designed such that they will not pollute groundwater. The Panhandle Health District in cooperation with the local building officials have been working together to identify potential environmental impacts in the planning stage and mitigate these areas of potential concern prior to construction.

Subsurface Sewage Disposal Systems

Local health districts regulate the siting of septic systems. These regulations can be used to control housing density. In northern Idaho, the impact of septic tanks has been tied to the presence of nitrate in waters of the Rathdrum Prairie Aquifer. Measurements conducted on a monthly basis from July 1975 through November 1976 and quarterly since then have documented an increase of nitrate contamination under areas where high-density septic tank use exists (Jones and Lustig, 1977).

Jones and Lustig (1977) showed that there was an increase in nitrate above historical background levels in areas experiencing rapid growths in population. Specific high nitrate levels and well locations were down-gradient from Post Falls, Coeur d'Alene and Dalton Gardens. All thee areas had experienced rapid housing growth during the years 1970-1976, utilizing subsurface sewage disposal methods exclusively.

On October 11, 1977, the Panhandle District Health Department officially adopted the "Rathdrum Prairie Aquifer Regulations." These regulations state, in part, that (1) a minimum lot size of five acres is required for a septic system and (2) development would be allowed on lots less than five acres provided land is located in an area programmed for a sewer system in compliance with a Sewage Management Agreement developed between the municipality and the Panhandle Health District Board of Health.

Minidoka County requires all new subdivisions to be sewered. Health District 4 requires a five-acre minimum lot size for septic systems in southwest Boise due to water quality problems associated with seasonal high groundwater.

Another approach used in California and Ohio involves setting up septic maintenance districts. These are special purpose units of government that set and enforce septic system design and maintenance standards. Routine pumping and replacement of failing systems is undertaken by the district using revenues from special assessments.

Mandatory Sewer Hookups

Public sewer systems control groundwater pollution by reducing the amount of wastes that the land receives. Requiring mandatory sewer hookups in sewered areas further reduces the waste the land is required to treat and helps control this type of nonpoint source pollution.

Cape Cod, Massachusetts and Suffolk County, New York, have sanitary codes which restrict the siting of industrial operations that use, generate, transport or dispose of hazardous waste within any zone which is mapped as highly vulnerable to groundwater contamination.

The time to protect Idaho's groundwater is now, while the quality is still good. Prevention of contamination is essential to maintain the quality of groundwater for drinking, industrial and agricultural uses. Maintaining high quality groundwater is an important factor in economic development. Of increasing concern nationwide is the liability that developers assume when purchasing property that has degraded groundwater quality. Maintaining high quality groundwater helps to ensure economic development opportunities. Local governments have the unique opportunity to develop groundwater protection programs suited to their specific needs.

Department of Health and Welfare, Division of Environmental Quality, Bureau of Water Quality

The Department of Health and Welfare, Bureau of Water Quality, has been designated as having lead responsibility for groundwater quality management in Idaho. The Groundwater Unit within the Bureau has this specific purpose.

Division of Environmental Quality, Groundwater Unit, Boise--334-5845

Division of Environmental Quality, Field Offices

Boise--334-3823
Coeur d'Alene--667-3524
Lewiston--799-3430
Twin Falls--734-9520
Pocatello--236-6160

Division of Environmental Quality, Bureau of Hazardous Materials, Boise--334-5879

District Health Departments

- A network of district health offices performs some groundwater protection functions. Included are inspection of sanitary landfills and subsurface sewage disposal systems.
- The district health departments also perform drinking water program activities for some private, commercial, industrial and small public water systems.
- The Panhandle District Health Department coordinates several activities in managing the water quality of the Rathdrum Prairie Aquifer.

District 1, Panhandle District Health Department,
Coeur d'Alene--667-3481
District 2, Lewiston--799-3100
District 3, Caldwell--459-0744
District 4, Boise--375-5230
District 5, Twin Falls--734-5900
District 6, Pocatello--233-9080
District 7, Idaho Falls--523--5382

Idaho Department of Water Resources--334-7900

- The Department of Water Resources (IDWR) manages both shallow and deep waste disposal and injection wells.

- Regulates the drilling of water wells.

- Many site and regional studies of groundwater quantity and quality have been conducted by the Department.

Department of Agriculture--334-3240

- Provides technical assistance on agricultural chemicals and assists in designing special monitoring studies.

- Regulates pesticide application and waste handling.

Department of Lands--334-3116

- The State Land Board functions as the Oil and Gas Commission.

- The Department administers regulations governing the issuance of geothermal resource leases.

- Regulations adopted for the drilling of all these wells contain controls to safeguard groundwater quality.

FEDERAL AGENCIES

U.S. Geological Survey, Water Resources Division--334-1750

U.S. Bureau of Land Management--334-1582

U.S. Bureau of Reclamation--334-1906

U.S. Environmental Protection Agency, Boise Office, 334-1450

U.S. Environmental Protection Agency, Region X, Office of Groundwater, Seattle, Washington (206) 442-1216

GLOSSARY

Aquifer	An underground soil or rock zone that contains usable amounts of groundwater
Confined Aquifer	Water contained in an aquifer which is overlain by a confining or impermeable layer
Groundwater	Water under the surface of the earth
Infiltration	Seepage of water through pore spaces in soil and rocks
Leachate	Water which has dissolved contaminants through infiltration or mixing with wastewater
Nonpoint source pollution	Cumulative groundwater contamination caused by diffuse and intermittent activities where there is no one individual responsible party (e.g., septic systems, agricultural and silvicultural activities)
Permeability or hydraulic conductivity	The rate at which water will move through a media (e.g., clays are often nearly impermeable, while sands and gravels can be highly permeable)
Porosity	The amount of open pore space in soil or rock
Recharge	Water coming into the groundwater system such as infiltration from precipitation
Saturated zone	The area below the water table where open spaces are filled with water
Unconfined Aquifer	Water which only partly fills an aquifer and the upper surface of the saturated zone is free to rise and fall
Unsaturated zone	The area between the ground surface and the water table (sometimes called the zone of aeration)
Water table	The top surface of the saturated zone (excluding the capillary fringe) in an unconfined aquifer

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